

WHAT IS CLAIMED IS:

1 1. A lithium secondary battery comprising an electrode and
2 a nonaqueous electrolyte, the electrode comprising an active
3 material layer provided on a current collector and containing an
4 active material which is capable of electrochemically occluding and
5 releasing lithium and having cracks formed in the layer by
6 occlusion and releasing of lithium, the cracks of the active
7 material layer being filled with the nonaqueous electrolyte in the
8 form of a solid electrolyte.

1 2. The lithium secondary battery according to claim 1,
2 wherein the entirety of the nonaqueous electrolyte is the solid
3 electrolyte.

1 3. The lithium secondary battery according to claim 1,
2 wherein the nonaqueous electrolyte partially comprises the solid
3 electrolyte.

1 4. The lithium secondary battery according to claim 1,
2 wherein the solid electrolyte is a gel polymer electrolyte
3 comprising a polymer and an electrolyte containing a lithium salt.

1 5. The lithium secondary battery according to claim 4,
2 wherein the polymer is a polyether solid polymer, polycarbonate
3 solid polymer, polyacrylonitrile solid polymer, copolymers of at
4 least two of these polymers or crosslinked polymers thereof.

1 6. The lithium secondary battery according to claim 1,
2 wherein a surface roughness (Ra) of a surface of the current
3 collector is at least 0.2 μm .

1 7. The lithium secondary battery according to claim 1,
2 wherein the current collector is a copper foil, a copper alloy foil
3 or a metal foil having a copper layer or a copper alloy layer on a
4 surface thereof.

1 8. The lithium secondary battery according to claim 1,
2 wherein the current collector is an electrolytic copper foil, an
3 electrolytic copper alloy foil or a metal foil having an
4 electrolytic copper layer or an electrolytic copper alloy layer on
5 a surface thereof.

1 9. The lithium secondary battery according to claim 1,

2 wherein the active material layer is formed by sintering, under a
3 non-oxidizing atmosphere, a slurry comprising particles of the
4 active material and a binder applied on the surface of the current
5 collector.

1 10. The lithium secondary battery according to claim 9,
2 wherein the binder remains after sintering.

1 11. The lithium secondary battery according to claim 9,
2 wherein the binder is a polyimide.

1 12. The lithium secondary battery according to claim 9,
2 wherein the mean diameter of the active material particles is 10 μm
3 or less.

1 13. The lithium secondary battery according to claim 9,
2 wherein an electrically-conductive powder is mixed in the slurry,
3 and the electrically-conductive powder is included in the active
4 material layer.

1 14. The lithium secondary battery according to claim 9,
2 wherein the active material layer is formed by coating the slurry

3 on the current collector, drying the slurry, rolling the dried
4 slurry and then sintering.

1 15. The lithium secondary battery according to claim 1,
2 wherein the active material layer is deposited on the current
3 collector as a thin film.

1 16. The lithium secondary battery according to claim 1,
2 wherein the active material is silicon, tin, germanium, aluminum,
3 or an alloy containing these elements.

1 17. A method for manufacturing a lithium secondary battery
2 comprising a nonaqueous electrolyte and an electrode on which an
3 active material layer containing an active material capable of
4 electrochemically occluding and releasing lithium is formed on a
5 current collector, wherein cracks which are formed in the active
6 material layer by occlusion and release of lithium are filled with
7 a solid electrolyte, comprising:

8 preparing a temporary-battery comprising the electrode and the
9 electrolyte comprising a lithium salt;

10 forming cracks in the active material layer by charging and
11 discharging the temporary-battery;

12 adding a polymerizable monomer to the electrolyte in the
13 temporary-battery and polymerizing the monomer to form the solid
14 electrolyte and to fill the cracks with the solid electrolyte.

1 18. A lithium secondary battery comprising an electrode and
2 a nonaqueous electrolyte, the electrode comprising an active
3 material layer formed on a current collector by deposition of an
4 active material which is capable of electrochemically occluding and
5 releasing lithium and having cracks formed in the layer by
6 occlusion and releasing of lithium, the cracks of the active
7 material layer being filled with the nonaqueous electrolyte in the
8 form of a solid electrolyte.

1 19. A method for manufacturing a lithium secondary battery
2 comprising a nonaqueous electrolyte and an electrode on which an
3 active material layer containing an active material capable of
4 electrochemically occluding and releasing lithium is formed as a
5 thin film on a current collector, wherein cracks which are formed
6 in the active material layer by occlusion and release of lithium
7 are filled with a solid electrolyte, comprising:

8 preparing a temporary-battery comprising the electrode in
9 which an active material layer containing an active material

capable of electrochemically occluding and releasing lithium is
formed by depositing a thin film of the active material on a
current collector, and the electrolyte comprising a lithium salt;
forming cracks in the active material layer by charging and
discharging the temporary-battery;
adding a polymerizable monomer to the electrolyte in the
temporary-battery and polymerizing the monomer to form the solid
electrolyte and to fill the cracks with the solid electrolyte.